Citation:

Elwood PC, Givens DI, Beswick AD, Fehily AM, Pickering JE, Gallacher J. The survival advantage of milk and dairy consumption: An overview of evidence from cohort studies of vascular diseases, diabetes and cancer. *J Am Coll Nutr.* 2008; 27 (6): 723S-734S

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Study Design:

Systematic review and meta-analysis

Class:

M - Click here for explanation of classification scheme.

Research Design and Implementation Rating:

POSITIVE: See Research Design and Implementation Criteria Checklist below.

Research Purpose:

- To report the results of a literature search for prospective cohort and case-control studies of milk and dairy consumption as predictors of vascular disease and diabetes and meta-analyses of the results in the papers identified
- To summarize the conclusions of the recent report by the World Cancer Research Fund and American Institute for Cancer Research
- To examine the evidence related to consumption of whole vs. reduced fat milks and consider the likely effect of milk and dairy consumption on survival.

Inclusion Criteria:

- Using Cochrane systematic review methods the computerized database MEDLINE was searched up to June 2008. Each search was limited to human/adult. The key words Milk/milk protein/dairy/dairy calcium produced 11,102 hits. Heart disease/coronary artery disease/myocardial infarction/ischaemic heart disease produced 125,572 hits and stroke produced 61,878 hits. Diabetes/metabolic syndrome gave 58,473 hits. Combined, these gave 180 papers on milk etc. and heart disease etc, 33 papers on milk and stroke and 111 on milk and diabetes
- Papers that included the following were reviewed: Population based and prospective, gave baseline data on milk or dairy consumption, vascular disease outcome or incident diabetes
- The references listed in each of these selected papers were also searched for other suitable reports. For heart diseases 11 papers were found to be relevant and to contain the data necessary for inclusion in a meta-analysis; for stroke seven and for diabetes four papers. Cross sectional case-control papers were also identified for the metabolic syndrome (four papers) and for myocardial infarction four.

Exclusion Criteria:

Results were reported excluding estimates.

Description of Study Protocol:

- *Recruitment:* Not applicable
- *Design:* Review and meta-analysis
- *Dietary intake/Dietary assessment methodology:* Not applicable
- *Blinding used:* Not applicable
- *Intervention:* Not applicable
- *Statistical analysis:*
    - Reported adjusted relative risks (RR) given in each paper were noted. Pooled estimates of the RR were determined by weighting the natural logs of the reported RR in each report by the inverse of the variance. Where variance was not estimable from confidence intervals, the standard error from a study of similar size was used
    - To estimate the effect of milk or dairy consumption on survival, they relate the data on disease risks to data on mortality in a major part of the UK (England and Wales) from the various life-shortening diseases considered (vascular disease, diabetes and cancer)
    - Studies which give disease risks in relation to the type of milk, whole or fat-reduced, within the same cohort, were examined.

Data Collection Summary:

- *Timing of measurements:* Not applicable
- *Dependent variables:* Not applicable
- *Independent variables:* Not applicable
- *Control variables:* Not applicable.

Description of Actual Data Sample:

- *Initial N:* The initial search found: 180 papers on milk and heart disease, 33 papers on milk and stroke and 111 on milk and diabetes
- *Attrition:* For the meta-analyses, 11 papers were used for cardiovascular disease (CVD), seven papers were used for stroke and four papers were used for diabetes. Cross-sectional case-control papers were also identified for review of metabolic syndrome (four) and myocardial infarction (four)
- Age: Age of the study participants was not stated
- *Ethnicity:* Ethnicity of the study participants was not stated
- *Other relevant demographics:* Not applicable
- *Anthropometrics:* Were not stated
- *Location:* Location of the studies was not stated.

Summary of Results:

Metabolic Syndrome

Overall, the data on the metabolic syndrome suggest a reduced incidence from milk and dairy consumption. There was a reduction in metabolic syndrome in subjects with the highest milk consumption (RR and 95% CI: 0.74; 0.64, 0.84).

Study	Total Number of Subjects	Dietary Item	Groups Compared	Number With the Syndrome	Adjustments for Possible Confounding	Adjusted RR[1] in High Milk Subgroups
Mennen et al [16]	2,439 Males	Dairy	Four or more portions per day vs. less than one per day	660	Age, energy, waist-hip ratio	0.63 (0.40-0.99)[2]
	2,537 Females			941		0.76 (0.47-2.66)[3]
Azadbakht et al [17]	827 Subjects	Dairy	Top and bottom quartile	97	Age, sex, activity, smoking, BMI, waist/hip ratio, energy, various foods, anti-hypertensive and estrogen therapy	0.75 (0.63-0.96)
Liu et al [18]	10,066 Females	Milk	Top and bottom quintile	1,731	Age, smoking, exercise, alcohol multivitamins parental MI	0.85 (0.71-1.02)[4]
		Dairy				0.66 (0.55-0.80)[5]
Elwood et al [19]	2,251 Males	Milk	One pint per day vs. under a third per day	342	Age, smoking, social class, IHD, BMI, energy, alcohol, fasting total cholesterol HDL cholesterol and triglycerides	0.38 (0.18-0.78)

SUMMARY ESTIMATE:

Relative risk (RR) of the metabolic syndrome in the high milk group 0.74 (95% CI 0.64-0.84)

[1] RR (95% CI).[2] Males.[3] Females.[4] Milk.[5] Dairy.

Myocardial infarction (MI) (Table 2 and 3): Overall, the data on MI suggest a reduced incidence from milk and dairy consumption. There was a reduction in MI events in subjects with

the highest milk consumption (RR and 95% CI: 0.83 (0.66-0.99).

Table 2. Summary of Case-Control Studies of Milk and MI

Study	Dietary Item	Number of Cases	Number of Controls	RR[1]
Gramenzi et al [24]	Milk intake	287	649	0.90
Tavani et al [25]	Milk intake	507	478	0.78 (0.54-1.12)
Lockheart et al [26]	Dairy intake	106	105	0.82 (0.58-1.16)
Biong et al [27]	Dairy fat intake	111	107	0.67 (0.24-1.83)

SUMMARY ESTIMATES:

RR of MI in the high milk group 0.83 (95% CI 0.66-0.99)
(Excluding Gramenzi et al [24] with estimated variance 0.79 (0.59-0.99)

[1] RR (95% CI).

Table 3. Prospective Cohort Studies on Milk or Dairy Consumption and Incident Vascular Disease Events

Study	Number of Subjects	Duration of Follow-up	Number of Events	Groups Compared	Adjustments for Possible Confounding
Milk and Dairy Foods					
Snowdon et al [28]	24,172 Subjects	20 years	758 male IHD deaths 841 female IHD deaths	Two glasses of milk per day vs. none	Age, smoking and other food items, weight and marital status
Shaper et al[29]	7,735 Males	9.5 years	608 IHD events	Milk drunk and taken on cereals vs. none	Age, social class, smoking, cholesterol, blood pressure and diabetes

Abbott et al [30]	3,150 Males	22 years	229 strokes	16 ounces per day milk drunk vs. non-drinkers	Age, dietary K and Na, alcohol, smoking, activity, cholesterol and glucose, uric acid and haematocrit
Mann et al [31]	10,802 Vegetarian subjects	13 years	63 IHD deaths	More than 1/2 pint milk per day vs. less than 1/2 pint	Age, sex, smoking and social class
Bostick et al [32]	34,486 Females	8 years	387 IHD deaths	Top and bottom quartile	Age, energy, BMI, waist-hip ratio, diabetes, smoking, Vitamin E and saturated fat
Kinjo [33]	223,170 Subjects	15 years	11,030 strokes	Milk four or more times per week vs. less than once per week	Sex, age, area, smoking, alcohol and occupation
Hu et al [34]	80,082 Females	14 years	939 vascular events	More than two glasses of milk per day vs. less than one glass per week	Time period, BMI, smoking, menopause, parental history, Vitamin E, alcohol, hypertension, aspirin use and exercise
Ness et al [35]	5,765 Males	25 years	892 IHD deaths 892 IHD deaths	More than one pint per day vs. less than one third per day	Social class, health behavior and health status
Elwood et al [36]	2,512 Males	20 years	493 IHD events 185 strokes	One or more pint per day vs. one third of a pint or less per day	Age, smoking, social class, IHD, BMI, energy, alcohol, fasting cholesterol, HDL-C and triglycerides
Sauvaget et	40,349	16 years	1,462 stroke	Milk almost daily	Smoking, alcohol, BMI, education,

al [38]	Subjects	16 years	stroke deaths	Dairy almost daily	diabetes, hypertension and area
Lamarche [37]	2,000 Males	13 years	217 IHD events	Above and below average intake of dairy products	Age, smoking, BMI, diabetes
Dairy or Total Dietary Calcium Intake					
Vijvjer et al [39]	2,606 Subjects	28 years	366 male IHD deaths 178 female IHD deaths	Top and bottom quintile	Age, smoking, BMI, SBP, cholesterol, energy and alcohol
Iso et al [40]	85,764 Females	14 years	690 strokes	Top and bottom quintile	Age, smoking, time interval, BMI, alcohol, menopause, hormone use, exercise, multivitamins, fatty acid intake, history of hypertension, diabetes and cholesterol
Al-Delaimy et al [41]	39,800 Males	12 years	1,458 IHD events	Top and bottom quintile	Age, duration, energy, diabetes, hypercholesterolaemia family history, smoking, aspirin, BMI, alcohol, activity, Vitamin E and various nutrients
Umesawa et al [42]	21,068 Males 32,319 Females	10 years	234 IHD deaths 566 stroke deaths	Top and bottom quintile of dairy calcium intake	Age, BMI, hypertension, diabetes, smoking, alcohol, potassium and energy

Ishcaemic Heart Disease (IHD) and Stroke (Table 4):

- Overall there was a reduction of about 10 to 15% in the incidence of IHD in the subjects who had reported drinking the most milk, relative to those drinking the least milk (0.91 (95% CI 0.82-1.00) and 0.84 (95% CI 0.76-0.93).
- The meta-analysis indicates about a 20% reduction in stoke events in the subjects who had reported drinking the most milk, relative to those drinking the least milk within each cohort (0.79 (95% CI 0.75-0.82).

Table 4. Meta-analysis of Prospective Studies of Milk and Dairy Consumption, Ischaemic Heart Disease and Stroke

Study	Number of Subjects	Number of Events	Predictive Factor	Adjusted RR (95% CI)
Ischaemic heart disease				
Snowdon et al [28] (males)	8,724	758	Milk	0.94
(females)	15,448	841		1.11
Shaper et al [29]	7,735	608	Milk	0.88 (0.55-1.40)
Mann et al [31]	10,802	63	Milk	1.50 (0.81-2.78)
Bostick et al [32]	34,486	387	Milk	0.94 (0.66-1.35)
Hu et al [34]	80,082	939	Whole milk	1.67 (1.14-1.90)
			Low-fat milk	0.78 (0.63-0.96)
			High-fat dairy	1.04 (0.96-1.12)
			Low-fat dairy	0.93 (0.85-1.02)
Ness et al [35]	5,765	892 deaths	Milk	0.68 (0.40-1.13)
Elwood et al [36]	2,512	493	Milk	0.71 (0.40-1.26)
Al Delaimy et al [41]	39,800	1,458	Dairy calcium	1.03 (0.86-1.26)
van Vijjver et al [39] (males)	1,340	366	Dietary	0.77 (0.53-1.11)

(females)	1,265	178	calcium	0.91 (0.55-1.50)
Lamarche [37]	2,000	217	Dairy intake	0.73 (0.56-0.93)
Umesawa [42]	53,387	234 deaths	Dairy calcium	0.80 (0.45-1.44)
Stroke				
Kinjo et al [33]	223,170	11,030	Milk	0.79 (0.75-0.83)
Ness et al [35]	5,765	196 deaths	Milk	0.84 (0.31-2.30)
Sauvaget et al [38]	40,349	1,462	Milk	0.94 (0.79-1.12)
			Dairy products	0.73 (0.57-0.94)
Elwood et al [36]	2,512	185	Milk	
Abbott et al [30]	3,150	229	Dairy calcium	0.67 (0.45-1.00)
Iso et al [40]	85,764	690	Dairy calcium	0.83 (0.66-1.04)
Umesawa [42]	53,387	566 deaths	Dairy calcium	0.53 (0.34-0.81)

SUMMARY ESTIMATES:

- RR of IHD in the high milk group, including Hu et al [34] whole milk: 0.91 (95% CI 0.82-1.00), see note 1 below(Excluding Snowdon et al [28] with estimated variance: 0.90 (0.80-0.99))
- RR if IHD in the high milk group, including Hu et al low-fat milk: 0.84 (95% CI 0.76-0.93) see note 2 and 3
  (Excluding Snowdon et al [28] with estimated variance: 0.83 (0.74-0.91))
- RR of stroke in the high milk group: 0.79 (95% CI 0.75-0.82).

1. When the estimates of Hu et al of 1.67 for whole milk is included there is considerable heterogeneity: (I^2=54.1%)
2. There is homogeneity when their estimate of 0.78 for low-fat milk is used in the meta-analysis
3. The estimates by Hu et al for dairy foods were not included in the meta-analyses.

Diabetes: RR for type 2 diabetes was estimated to be 10% lower in people who had a high milk intake (0.92; 0.86-0.97) (Table 5).

Table 5. Prospective Studies of Milk or Dairy Consumption and Incident Diabetes

Study	Number of subjects	Duration of follow-up	Groups compared	Number who developed diabetes	Adjustments for possible confounding	Adjusted RR[1]
Choi et al [51]	41,254 Males	12 years	Top and bottom quintiles of total dairy	1,243	Age, total energy, follow-up time, family history, smoking, BMI, hypercholesterolaemia, hypertension, activity, alcohol and certain nutritional factors	0.91 (0.85-0.97)
Liu et al [52]	37,183 Females	10 years	Two or more servings of dairy foods per week vs. less than one serving per month	1,603	Age, total energy, diabetes in family, smoking, BMI, hypercholesterolaemia, hypertension, hormone therapy, activity, total fat, glycaemic load, diet Ca, Vitamin D and Mg	1.04 (0.84-1.30)[2]
						0.92 (0.78-1.09)[3]
van Damm et al [53]	41,186 Females	8 years	Quintiles of dietary calcium intake	1,964	Age, total energy, BMI, smoking, physical activity, alcohol, parental diabetes, education, coffee and soft drinks, processed and red meat	0.93 (0.75-1.15)
Elwood et al [19]	640 Males	20 years	Highest quartile of milk intake vs. lowest quartile	41	Age, smoking, BMI and social class	0.57 (0.20-1.63)

SUMMARY ESTIMATES:

RR of incident diabetes in the high milk group 0.92 (0.86-0.97) (using the estimate by Liu et al [52] for low-fat milk 0.91 (0.86-0.96)

[1] RR (95% CI).[2] Whole milk.[3] Skimmed milk.

Cancer (Table 6): An increased consumption of milk or dairy food is associated with significant

reduction in colon cancer, RR attributable to milk being between 0.78 and 0.94 per serving per day in pooled cohort studies. There is a significantly increased risk of prostate cancer, risk associated with milk and dairy consumption in pooled cohort studies being 1.06 (1.01, 1.11) per serving per day. Milk and dairy consumption associated with increased risk of bladder cancer, estimate of risk from pooled cohort studies 0.82 (0.67, 0.99) per serving per day. No relationship of importance was reported for any other cancer.

Table 6. Summary of Relationships between Milk or Dairy Consumption and Cancer Taken From the Report of the World Cancer Research Fund [5]

Cancer	Predictor	Number of Studies	Pooled Relative Risk[1]	Heterogeneity
Colorectal	Milk	4 cohorts	0.94 (0.85-1.03)	'low'
	Milk	10 cohorts	0.78 (0.69-0.88)	Not state
Prostate	Milk	8 cohorts	1.05 (0.98-1.14)	'low'
	Milk	6 case-control	1.08 (0.98-1.19)	'moderate'
	Milk and dairy	8 cohorts	1.06 (1.01-1.11)	'moderate'
	Milk and dairy	5 case-control	1.03 (0.99-1.07)	'low'
Bladder	Milk	4 cohorts	0.82 (0.67-0.99)	'moderate'
	Milk	3 case control	1.00 (0.87-1.14)	'high'

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Whole and fat-reduced milks: The authors concluded that persons who choose to drink fat-reduced milks were more likely to adopt other "healthy behaviors" that could confound the results. Therefore, no conclusions were given for whole vs. reduced-fat milks.

Table 7. Relationships with Whole Milk and Fat Reduced Milks Compared

Study	Total Number in the Study	Type of Study	Outcome Disease	RR in Highest 1/4 or 1/5	
				Whole Milk (1) High fat Dairy (3)	Fat Reduced (2) Low fat Dairy (4)
Hu et al [34]	80,082 Females	Prospective	Ischaemic heart disease	1.67 (1.14-1.90)[1]	0.78 (0.63-0.96)[2]
				1.08 (0.96-1.12)[3]	0.82 (0.85-1.02)[4]
Tavani et al [25]	985 Subjects	Case-control	Fatal MI	0.89 (0.57-1.38)[1]	0.83 (0.59-1.16)[2]
Lockheart et al [26]	211 Subjects	Case-control	MI	0.48 (0.20-1.14)[3]	0.96 (0.42-2.23)[4]

Lui et al [18]	10,066 Females	Cross sectional	Metabolic syndrome	0.71 (0.58-0.87)[3]	0.78 (0.64-0.95)[4]
Choi et al [51]	41,254 Males	12 years prospective	Diabetes	1.19 (1.00-1.43)[1]	0.95 (0.80-1.13)[2]
Liu et al [52]	37,183 Females	10 years prospective	Diabetes	1.00 (0.96-1.05)[3]	0.92 (0.84-1.01)[4]
van Dam et al [53]	41,186 Females	8 years prospective	Diabetes	1.03 (0.88-1.20)[3]	0.87 (0.76-1.00)[4]
Mettlin et al [54]	2,561 Subjects	Case control	Colon cancer	1.8; 1.3-2.4[1]	1.0 (0.7-1.4)
			Rectal cancer	2.0; 1.4-2.8[1]	0.8 (0.5-1.3)[2]
			Prostate cancer	1.5; 1.0-2.2[1]	1.2 (0.7-2.1)[2]
			Bladder cancer	2.0; 1.3-3.1[1]	0.6 (0.3-1.2)[2]
Veierod et al [55]	25,708 Males	9-15 years prospective	Prostate cancer	Set at 1.0[1]	2.2 (1.3-3.7)[2]
Sing and Frazer [56]	32,051 Subjects	6 years prospective	Colon cancer	1.04 (0.69-1.59)[1]	0.97 (0.66-1.42)[2]
Michaud et al [57]	51,529 Males	10 year Prospective	Prostate cancer	1.12 (0.70-1.8)[1]	1.37 (0.90-1.5)[2]
Kampman et al [58]	16,945 Subjects	Case control	Colon cancer	1.1 (0.8-1.5) [3,5]	0.8 (0.6-1.0) [4,5]
				0.9 (0.6-1.2) [3,6]	0.7 (0.5-1.0) [4,6]
Tseng et al [59]	3,612 Males	Prospective	Prostate cancer	0.8 (0.5-1.3)[1]	1.5 (1.1-2.2)[2]
Gallus et al [60]	3,247 Subjects	Case control	Colon cancer	0.99 (0.86-1.13)[1]	0.84 (0.73-0.97)[2]
			Rectal cancer	1.22 (1.03-1.44)[1]	0.76 (0.64-0.91)[2]
			Prostate cancer	1.06 (0.90-1.25)[1]	1.11 (0.94-1.31)[2]

[1] Whole milk.[2] Low-fat milk.[3] High fat dairy.[4] Low-fat dairy.[5] Males.[6] Females.

Author Conclusion:

- The analyses gives fairly clear evidence of a reduction in vascular disease and type 2 diabetes by milk and dairy consumption. Taken together with the probable reduction in colon

cancer and allowing for some increase in prostate cancer there is fairly convincing overall evidence that milk and dairy consumption is associated with an increase in survival in Western communities
- The gradient in milk intakes may contribute to health inequalities.

Reviewer Comments:

Regarding the survival advantage of milk or dairy consumption

- *The authors did not estimate an overall quantitative survival advantage and acknowledged the large number of assumptions needed*
- *They state that after considering the number of death from various causes were taken into account, the data suggests that there is an overall reduction in the number of deaths and hence an increase in overall survival attributable to consumption of milk and dairy foods.*

Research Design and Implementation Criteria Checklist: Review Articles

Relevance Questions		
1.	Will the answer if true, have a direct bearing on the health of patients?	Yes
2.	Is the outcome or topic something that patients/clients/population groups would care about?	Yes
3.	Is the problem addressed in the review one that is relevant to nutrition or dietetics practice?	Yes
4.	Will the information, if true, require a change in practice?	Yes

Validity Questions		
1.	Was the question for the review clearly focused and appropriate?	Yes
2.	Was the search strategy used to locate relevant studies comprehensive? Were the databases searched and the search termsused described?	Yes
3.	Were explicit methods used to select studies to include in the review? Were inclusion/exclusion criteria specified and appropriate? Were selection methods unbiased?	Yes
4.	Was there an appraisal of the quality and validity of studies included in the review? Were appraisal methods specified, appropriate, and reproducible?	Yes
5.	Were specific treatments/interventions/exposures described? Were treatments similar enough to be combined?	Yes
6.	Was the outcome of interest clearly indicated? Were other potential harms and benefits considered?	Yes

7.	Were processes for data abstraction, synthesis, and analysis described? Were they applied consistently across studies and groups? Was there appropriate use of qualitative and/or quantitative synthesis? Was variation in findings among studies analyzed? Were heterogeneity issued considered? If data from studies were aggregated for meta-analysis, was the procedure described?	Yes
8.	Are the results clearly presented in narrative and/or quantitative terms? If summary statistics are used, are levels of significance and/or confidence intervals included?	Yes
9.	Are conclusions supported by results with biases and limitations taken into consideration? Are limitations of the review identified and discussed?	Yes
10.	Was bias due to the review's funding or sponsorship unlikely?	Yes